5.0 Geologic Conditions

5.1 Introduction

This chapter describes the existing environmental conditions and evaluates the consequences of the proposed project on geological conditions. It describes the geological conditions of the Delta area, evaluates and discusses the consequences associated with construction and operation of the project, and presents recommended measures to mitigate significant adverse impacts. The chapter concludes with a comparative evaluation of the alternatives to ISDP.

5.2 Existing Environment/Affected Environment

5.2.1 Introduction

Prior to the mid-1800s, the Delta islands consisted of flood basins filled with tules and marshland vegetation. The islands were separated by channels that were slightly elevated and were contained by natural levees of low relief which were easily overtopped by flooding episodes. These flooding cycles were essential to the formation of peat soils as the tules died when covered by water and new growth appeared as the islands drained. The presence of erosion resistant clays within the banktoe of the natural levees contributed to the stability and lack of migration of the channels. The lateral flood basins along the Sacramento and San Joaquin rivers provided storage and conveyance during flooding episodes, gradually releasing flows downstream, so that the channels in the Delta region were only moderately taxed by floods (Gilbert, G.K. 1917).

The thick alluvial deposits of the Delta consist of Recent alluvial sediments, underlain by Pliocene and Pleistocene formations. From older to younger, these formations are: Mehrten; Laguna; Arroyo Seco; Riverbank; and Victor/Modesto. They are commonly separated in the subsurface by buried soil horizons, indicating that the formations were deposited in phases, separated by periods of subaerial weathering. The subsurface is a complex intermingling of coarse sand and gravel bedload deposits, sand- and silt-sized overbank deposits, and silt- and clay-sized backswamp deposits. The Recent alluvial sediments which overlie these formations are generally dark-colored, often highly organic, and of mixed lithologic composition and origin. The Recent sediments along the eastern margin of the Delta are primarily derived from metamorphic sources in the Sierra Nevada foothills while the sediments along the western margin of the Delta are derived from the uplifted Tertiary sedimentary rocks of the Coast Range. The interfingering of these lithologic types is common away from the Delta margins (Shlemon 1969).

The present geomorphic state of the Delta is a function of the intensity of water management in each of the tributary rivers, local farming practices, intra- and inter-Delta water transfers, and an extensive manmade levee system. Upstream water diversions for municipalities and agriculture reduce the amount of flow entering the Delta and the amount of sediment transported to the Delta. In addition, conveyance of water within and out of the Delta alters flow directions and affects sedimentation and erosion rates and patterns. The levee system within the Delta

constricts flow to a network of manmade and natural channels that reduce flood events and inhibit the formation of new soils on the Delta islands. Over time, most of the Delta islands have subsided and are now lower than the surrounding water surface elevation.

Subsidence, or lowering of the land surface elevation, is exacerbated by farming practices. Most of the Delta islands are covered in thick layers of peat, a highly organic soil. Extensive farming on the islands exposes the peat soils to oxygen which creates a chemical reaction that literally destroys the organic soil and lowers the land level. Subsidence is a major concern in the Delta, increasing the water pressure on levees and, therefore, the probability of levee failure and flooding (DWR 1993b). Consequently, the levees are in need of continual maintenance. There are approximately 1,100 miles of levees protecting the 700,000 acres of "reclaimed" marshlands and uplands (SLC 1991). Over 500,000 acres of the Delta are in agricultural production. Without the levee system, approximately eighty five percent of the Delta would be a broad, shallow bay and estuary.

5.2.2 Soils

The soils in the south Delta have been mapped by the U.S. Department of Agriculture, Soil Conservation Service (SCS) and are described in the soil surveys of San Joaquin and Contra Costa counties. According to these surveys, soils in the south Delta are predominantly comprised of loams, clays, clay loams, silty clay loams, fluvaquents, and mucks. In general, all of these soils are very deep and very poorly to poorly drained depending on their respective percentages of clay and organic matter. The distribution of these soils in the south Delta is depicted in Figure 5-1. The Peltier-Egbert, Merritt-Grangeville-Columbia, Ringe-Kingile, and Sacramento-Omni soil associations occur on the deltas, flood plains, and levees and make up the majority of soils in the ISDP project area.

5.2.3 Seismicity

The Delta is subject to seismic risk because of its proximity to the San Andreas fault system, including the San Andreas, Hayward, Calaveras, Rogers Creek, Antioch, Green Valley-Concord, and Greenville faults. These faults are known to be historically active and are capable of generating earthquakes with sufficient magnitude to cause strong ground motion in the project area. Of these, the Greenville Fault Zone is nearest the ISDP project area, located about 11 miles away.

The proposed fish control structure and the three proposed flow control structures would be located within the western portion of San Joaquin County. The proposed intake structure would be located in the southeastern corner of Contra Costa County. These sites are located in Seismic Zone 3, as defined by the Uniform Building Code (UBC). The Zone 3 designation indicates earthquakes in the region have the potential to make standing difficult and to cause stucco and some masonry walls to fall. Structures must be designed to meet the regulations and standards associated with Zone 3 hazards.

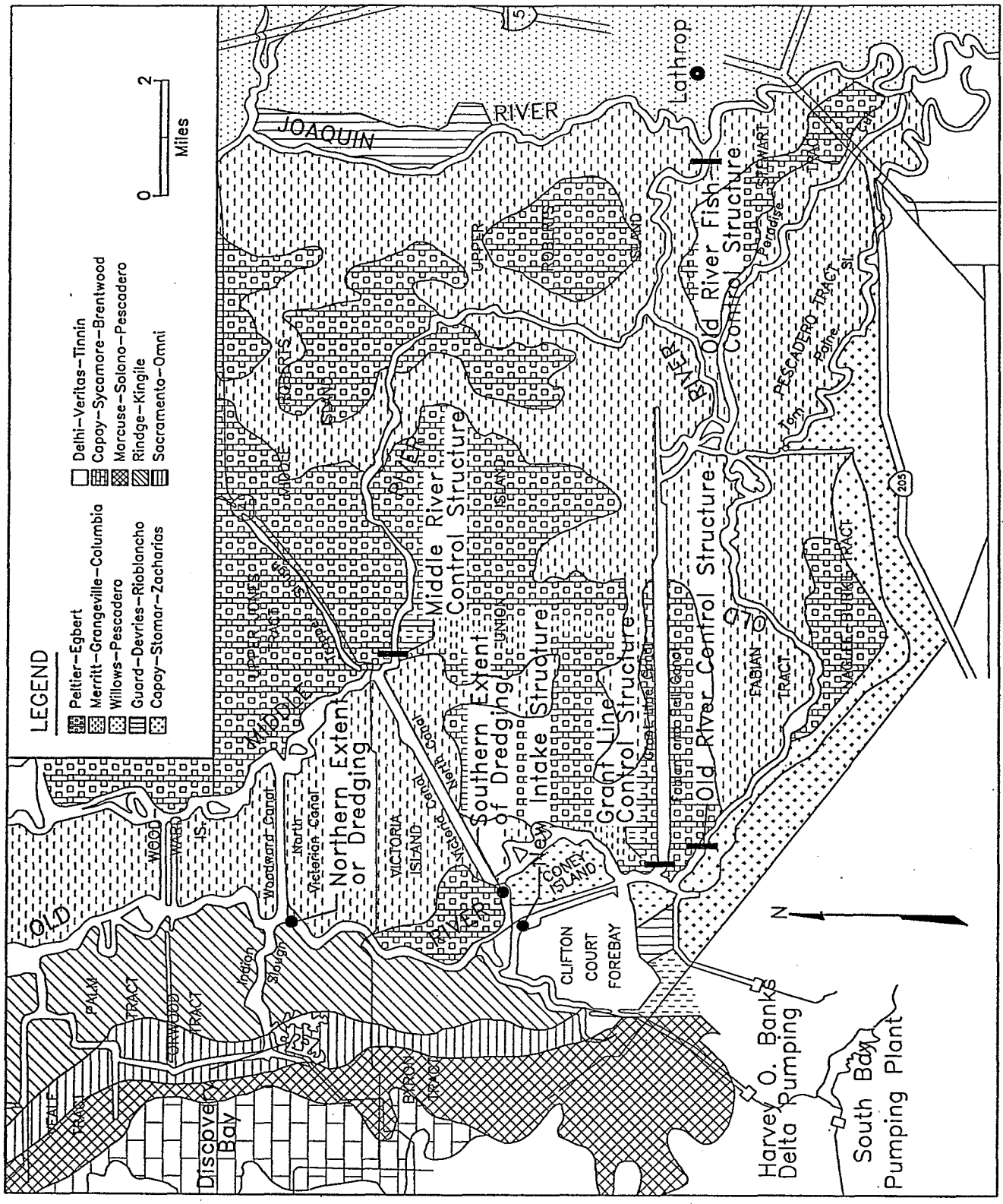

Figure 5-1. Soils of the South Delta.

Contra Costa County rates areas within the County based upon estimated seismic ground response associated with earthquakes. The County is divided into four Damage Susceptibility Zones. Zone 1 is expected to be the least susceptible to earthquake damage and Zone 4 is expected to have the highest damage susceptibility. The ISDP facilities are located in Zone 4.

Sediments in Zone 4 are weak, water saturated deposits that possess many adverse engineering characteristics. Stability during an earthquake is poor.

The earthquake-related hazards include localized ground shaking, seismically induced deformations, and liquefaction. Other geologic hazards in the Delta include subsidence, expansive soils, erosion, soil instability, and flooding associated with levee failure.

5.2.4 Mineral And Natural Gas Resources

Sand and gravel are the primary mineral resources of the Delta. The San Joaquin County General Plan (1992) identifies four areas in the County, referred to as sectors, containing regionally significant deposits of high-grade aggregate (sand and gravel). One aggregate extraction site is located in the ISDP project vicinity, at the confluence of the San Joaquin and Old Rivers, near the proposed Old River Fish Control Structure. This site has not been operated since 1991 (San Joaquin General Plan 1992). Peat soil has been mined since 1971. The Delta Humus Company removes the peat soil from a flooded portion of Venice Island and sells it to local growers and others who package the soil for retail sale. The Delta Humus Company is one of two companies in California that extract peat (San Joaquin General Plan 1992). The Delta serves as an important natural gas source and is also utilized as an underground gas storage area. Most natural gas extraction activities in San Joaquin and Contra Costa Counties take place in the vicinity of the Delta, but well away from the proposed ISDP facilities.

5.3 Environmental Impacts/Consequences

5.3.1 Introduction

The ISDP is designed to move water through the delta to the proposed northern intake structure without increasing erosion and sedimentation. Specifically, the dredging of Old River is included in ISDP to maintain flow velocities of less than three feet per second, a conservatively calculated scour threshold. As such, the following evaluation focuses upon the construction of the project rather than operation. The construction of the proposed intake structure, the fish control structure, the sediment storage ponds, the three flow control structures, and the dredging of Old River all involve grading or excavation of geologic materials. In addition, all of the constructed facilities could be affected by seismic activity. The criteria used in determining the significance of potential impacts are discussed first, in the following.

5.3.2 Significance Criteria

NEPA and CEQA provide guidance by which to judge whether a specific impact would be considered significant. Under NEPA, a "significant" impact is determined by considering the context in which it will occur and the intensity of the action. The significance of the action must be analyzed based on society as a whole, affected interests, the affected region, and the locality in which it would occur. The intensity refers to the severity of the impact. In most cases, the intensity of the impact related to geology and soils is dependent on: 1) the degree to which the proposed action affects public health or safety; and 2) whether the action threatens a violation of federal, state, or local law, or a requirement imposed for the protection of the environment.

Under CEQA, earth-related impacts are considered significant if implementation of a proposed alternative would: expose people or structures to major geologic hazards; cause substantial flooding, erosion or siltation; or exceed public, national, State, or local standards relating to solid waste control.

The Clean Water Act, Section 404(b)(1) guidelines provide environmental criteria used in evaluating proposed discharges of dredged materials into waters of the United States. For proposed discharges of dredged material to comply with the guidelines, they must satisfy four requirements found in Section 230.10 and summarized in the Draft Inland Testing Manual, as follows. Section 230.10(a) addresses those impacts associated with the loss of aquatic site functions and values of the proposed discharge site, by requiring that the discharge site represent the least environmentally damaging, practical alternative. Section 230.10(b) requires compliance with established legal standards (e.g., issuance or waiver of a State water quality certification). Section 230.10(c) requires that discharge of dredged material not result in significant degradation of the aquatic ecosystem. Section 230.10(d) requires that all practicable means be utilized to minimize adverse environmental impacts.

The Seismic Elements of the San Joaquin County and Contra Costa County General Plans contain goals, objectives, and policies are aimed at reducing the seismic risk to people and property. Any substantial conflict between ISDP and these goals, objectives, and policies would constitute a significant adverse impact.

5.3.3 Construction-Related Impacts

The potential construction-related impacts of ISDP are discussed in several subsections: seismicity, soil disturbance, grading and excavation, loss of farm land, runoff, caving, disposal of excavated materials, disposal of dredged materials, seepage and stability, and subsidence, as follows.

Seismicity. The construction area may be subject to strong ground shaking and liquefaction in the event of an earthquake greater than about 6.5 on the Richter scale on any one of the active faults in the San Francisco Bay region. Strong ground shaking and liquefaction could cause structural damage to the intake, flow control, and fish control facilities. These would be considered potentially significant adverse impacts.

Soil Disturbance. The soils to be graded or excavated by the construction of the intake, the fish control structure, and the flow control structures have been substantially disturbed by prior levee construction. These include Fluvaquents at the proposed intake site; Columbia fine sandy loam (clayey substratum) and Merritt silty clay loam at the site of the proposed fish control structure; Fluvaquents, Merritt silty clay loam, and Peltier muck clay loam at the Middle River control structure; Merritt silty clay loam and Peltier muck, clay loam at the Grant Line Canal control structure; and Grangeville fine sandy loam and Merritt silty clay loam at the Old River flow control structure. The use of these disturbed soils for construction is considered a less-than-significant impact.

Grading and Excavation. Grading, excavation, and loading activities could increase accelerated erosion and sedimentation. In addition, soils in the vicinity of the Middle River control structure, the Grant Line Canal control structure, the Old River flow control structure, and the settling ponds on Victoria Island are subject to soil blowing and this condition could be exacerbated by the use of trucks and heavy machinery. These adverse impacts would be considered significant.

Loss of Farm Land. The construction of the fish control structure, the Middle River control structure, and the Grant Line Canal control structure would each remove less than one acre of agricultural land from production. The construction of the Old River flow control structure would remove about 3.1 acres of agricultural land from production. The removal of a total of less than 4.1 acres of agricultural land from production is considered a less-than-significant impact.

The placement of dredge spoils on Victoria Island would preclude the continued use of approximately 614 acres of cultivated land for an undetermined period of time. The two parcels are currently considered prime farmland, and are under Williamson Act contract. The placement of dredge spoils on Byron Tract would preclude the continued use of approximately 360 acres of prime farmland and farmland of Statewide Importance. The settling ponds are expected to eventually return to agricultural use. The temporary loss of 360 or 614 acres for agricultural uses would be considered a significant and unavoidable adverse impact.

Runoff. Uncontrolled runoff from the construction sites, including the settling pond sites on Victoria Island or Byron Tract, could enter surface waters causing increased turbidity and a reduction in water quality. Uncontrolled discharges of sediment and storm water runoff to the waters of the State would conflict with the provisions of the Federal Clean Water Act and the California Water Code. As such, this would be considered a significant adverse impact.

Caving. Shallow excavations associated with the Old River fish control structure, the Grant Line Canal control structure, and the Old River flow control structure may be subject to caving owing to the presence of either the Columbia fine silty loam or the Grangeville fine sandy loam. Both of these soils are subject to caving when excavated, potentially creating a safety risk. Caving would be considered a significant adverse impact.

Disposal of Excavated Materials. There has been limited testing of soil materials at the construction sites, and an excavated materials disposal site has not been identified. Accordingly, DWR and Reclamation will test the excavated materials and transport them to appropriately licensed disposal sites. This will eliminate the potential for adverse effects upon the environment that might be related to the uncontrolled release of any hazardous or toxic substances contained in the materials.

Disposal of Dredged Materials. Three sediment cores were collected from the Old River channel in the proposed dredging area and tested for their suitability for disposal. In addition, one sample from each of the four proposed flow and fish control structure sites was collected and analyzed. The sampling methodology and laboratory results are summarized in a report entitled Environmental Study for the Interim South Delta Program Water, Sediment and Soil Quality (DWR 1994b). Eighteen additional sediment samples were collected and analyzed in a separate study for six sites along the 5-mile reach of Old River where dredging is proposed. The analyses are documented in a report, Water and Sediment Quality Study for the Interim South Delta Program (DWR 1995). The reports are available through Steve Roberts, DWR, 1416 Ninth Street, Sacramento, California. Two important conclusions were drawn in connection with the disposal of the dredge materials.

In addition, six sediment samples were collected in 1994, and another six samples were collected in 1996. The analysis of the 1994 samples are documented in a report, Water and Sediment Quality Study for the Interim South Delta Program (May 1995). The analysis of the 1996 samples is not yet completed, but will be documented in a report made available prior to release of the Final EIR/EIS. These reports can be obtained by calling Steve Roberts, DWR, 1416 Ninth Street, Sacramento, California.

First, the dredged materials would be suitable for disposal by direct placement on levees. The data indicate: 1) the sediments in the Old River channel would not be considered hazardous waste since none of the samples contained metals or organic compounds in concentration above the TTLC. 2) the 1994 sample analysis indicate the sediment samples appear to be suitable for upland disposal in the upland environment. None of the composite samples in the 1994 report contained contaminants in excess of the criteria contained in: *RWQCB-San Francisco Bay Region Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse [of Dredged Sediments]*, (RWQCB 1992). In the 1995 report, silver was the only metal to exceed the SFRWOCB criteria. The criterion of 1.0 mg/kg dry weight was exceeded in 12 of the 18 samples. Arsenic, chromium, copper, and nickel were found in concentrations exceeding the Ontario Lowest Effect Level at one or more sites. Using the San Francisco and Ontario criteria, it appears that the top 12 to 18-inches of sediment may not always be suitable for upland disposal. San Francisco and Ontario criteria may not be applicable in the south Delta, sine the south Delta is regulated by the Central Valley Regional Water Quality Control Board. CVRWOCB is currently formulating sediment screening criteria for the Sacramento-San Joaquin Delta region. The criteria are not specific to the Central Valley Region, but are based on the California Water Code and the Clean Water Act and provide useful guidance for decisions regarding the reuse of dredged spoils. The laboratory results suggest the Old River channel sediments may be acceptable for both cover and non-cover uses, which would include levee enhancement.

A third sediment study was performed in 1996. Laboratory analysis is not yet completed, but will be documented in a report and made available prior to release of the Final EIR/EIS.

Second, the discharge of a dredged material slurry into settling ponds on Victoria Island or Byron Tract may be more problematic, since ground and surface waters could be impacted by several heavy metals found in the sediments. Although the concentrations are relatively low, the presence of these contaminants suggests that the dredged spoils may be classified as a "designated waste" pursuant to the California Code of Regulations, Title 23, Chapter 15, Section 2522(a). A "designated waste" is defined as a "non-hazardous waste which consists of or contains pollutants which, under ambient environmental conditions at the waste management unit, could be released at concentrations in excess of applicable water quality objectives, or which could cause degradation of waters of the state." The discharge of water and sediment from the settling ponds, has the potential of degrading the waters of the State. This would be considered a significant adverse impact.

Seepage and Stability. The soils adjacent to and underlying the levees bordering the Old River channel are subject to lateral seepage. Lateral seepage through the levees or piping beneath the levee foundations could increase if the levees are undermined or weakened during dredging, or if permeable geologic strata are uncovered during the dredging. The condition could become exacerbated over time as the soils within the island continue to subside, further increasing pressure on the levees. The levees are also prone to structural failures associated with liquefaction, slumping, and differential settlement. Contributing factors include poor construction materials, erosion by current and wave action, seepage through or under the levee, rodent burrows and improper levee repairs (DWR 1982). The ISDP project description includes measures to assure the protection of the adjacent levees. These measures are described in *Interim South Delta Program, Byron Tract-Old River Levee Waterside Stability Analysis* (DWR 1996a), and include: limiting removal of material to the center two-third of the width of the existing channel; maintaining a minimum side slope of 3:1 along the new cross sections; and designing a series of benches for the new cross section. Seepage within the islands could result in higher pumping and drainage costs and crop production could potentially decrease. Increased pumping costs, crop losses, and flooding would be considered significant adverse impacts.

The soils adjacent to the levees at the Old River fish control structure site, and Middle River, Old River, and Grant Line flow control structure sites may be subject to increased seepage related to the post-construction water levels. An increase in seepage could lead to increased pumping costs, crop losses, and flooding. These potential seepage-related impacts to the adjacent agricultural properties are considered to be offset by the benefits relating to the higher water levels.

Subsidence. Placing sediment on Victoria Island or Byron Tract could lead to consolidation of the underlying materials and subsidence. According to a U.S. Army Corps of Engineers report, "fill placed on a peat foundation causes consolidation." Furthermore, "primary consolidation occurs in a short period (a few weeks to a few months) and can equal the height of the fill placed. Secondary consolidation continues indefinitely and the rate of consolidation decreases with time. This consolidation is a function of the height of fill, the thickness of the peat, and elapsed time" (USACOE 1982). Reports published by the Soil Conservation Service indicate peat soils

underlie Victoria Island. Therefore, some subsidence could be expected as a result of the placement of sediment and water on the island.

Reducing the elevation of the land surface could result in a number of adverse consequences. First, lowering the land surface elevation would increase problems associated with the high water table. Pumping and drainage costs could increase and crop production could decrease. Second, lowering the land surface could increase seepage problems. Finally, subsidence contributes to structural failure. These potential adverse consequences related to subsidence would be considered significant adverse impacts.

5.4 Mitigation Measures

Seismicity. All new structures associated with the ISDP shall be designed and constructed to resist seismic effects, according to specific site conditions, as provided in the Uniform Building Code (UBC). In addition, all new structures shall be designed to meet the implementation standards outlined in the San Joaquin and Contra Costa County General Plans. Implementation of the policies and goals outlined in the General Plans and adherence to specific UBC and County Building Codes will reduce the hazards associated with earthquakes.

Runoff. A Storm Water Pollution Prevention Plan (SWPPP) shall be developed by a qualified engineer and implemented prior to construction. The SWPPP shall be kept on-site during construction activity and shall be made available upon request to representatives of the Regional Board or local agency. The objectives of the SWPPP are: 1) to identify pollutant sources that may affect the quality of storm water associated with construction activity, and, 2) to identify, construct, and implement storm water pollution prevention measures to reduce pollutant in storm water discharges during and after construction. Therefore, the SWPPP will include a description of potential pollutants to storm water from erosion, management of dredged sediments, and hazardous materials present on-site during construction (including vehicle and equipment fuel). The SWPPP will also include details of how the sediment and erosion control practices described in the previous section will be implemented.

Caving. The construction-related excavations shall be shored or otherwise stabilized in accordance with engineering and regulatory safety standards.

Disposal of Dredged Materials. The potential significant adverse impacts related to the disposal of the dredged material slurry on Victoria Island or Byron Tract can be mitigated in the following ways. First, the settling ponds could be developed as a Class II "Waste Management Unit" (WMU), which must be: 1) underlain by geologic materials with specific permeability characteristics and thickness; 2) protected by natural or artificial barriers; 3) lined to conform with the requirements of Title 23, Chapter 15 of the California Code of Regulations; 4) designed to prevent inundation or washout due to floods with a 100-year return period; 5) setback 200-feet from a known Holocene fault; and 6) designed according to specified engineering criteria. An alternative would involve additional sediment testing to determine whether there are portions of the Old River channel suitable for discharge into the ponds without special WMU measures. The suitable dredged sediments could be disposed of on Victoria Island, while the areas found to contain unsuitable materials could be dredged by clamshell and transported to an appropriate

licensed disposal location. The unsuitable dredged materials appear to be acceptable for levee enhancement, and could be placed on the alternative disposal location at Twitchell Island.

Seepage. Dredging in the Old River Channel could lead to increased seepage through hydraulically connected strata. Impacts related to seepage would be mitigated by implementing a Seepage Monitoring Program and compensating local farmers for increased pumping costs and losses that result from seepage. The Seepage Monitoring Program would monitor changes in pumping rates, costs and crop production to determine the extent to which seepage, if any, is occurring. Based on the findings of the Seepage Monitoring Program, DWR shall compensate farmers affected by seepage for their increased pumping costs and crop losses due to ISDP.

Subsidence. Impacts related to subsidence can be avoided by implementing the following. Subsurface conditions in the vicinity of the proposed settling pond area shall be investigated. Soil borings shall be drilled throughout the settling pond area, to a depth of approximately 20 feet below ground surface to determine stratigraphic conditions beneath the settling pond area and the depth and thickness of peat units present. The borings shall be logged by a registered geologist or civil engineer. Samples of the peaty soils shall be collected from each boring. The samples shall be submitted to a geotechnical laboratory and the density of each sample shall be measured according to ASTM standards. These data shall be used in conjunction with the stratigraphic information to determine the maximum amount of compaction that could occur beneath the site. The settling pond process shall be designed to account for the type and depth of materials present below Victoria Island or Byron Tract. The sediment and water depth will be kept at a minimum to reduce the risk of settlement of the underlying soils. Eliminating the possibility of subsidence will reduce potential adverse impacts associated with increased pumping costs, crop losses and structural failures to less-than-significant levels.

Grading and Excavation. Significant impacts associated with grading and excavation activities can be reduced to less-than-significant levels by implementing the following erosion, sedimentation, and storm water control measures.

> *Erosion and sediment control measures shall be operable during the rainy season, October 1 to April 15, or at the end of each working day when the forecast of rain probability exceeds 40%, and shall be maintained throughout the construction project.*
>
> *Stabilization of exposed slopes and drainageways shall be accomplished before the first erosive rains of the season. Seeding shall be completed by September 15 to maximize the chances of intercepting the light, early-season rains and the chances of grass establishment by October 15.*
>
> *Vegetation shall be reestablished on all denuded areas that would not be covered by buildings or pavement.*
>
> *For slopes and drainageways in critical areas where failure of grass linings must be avoided, irrigation shall be conducted to ensure stabilization by October 15.*
>
> *Construction traffic shall be routed to avoid existing or newly planted vegetation. Unnecessary clearing of vegetation around construction areas shall also be avoided.*

During the rainy season, all paved areas shall be kept clear of earth material and debris.

Runoff shall not be allowed to cross denuded or newly seeded slopes or other critical areas except within drainage facilities such as stabilized drainageways, or pipe slope drains (for slopes steeper than 10:1). Dikes and ditches shall also be used at the base of disturbed slopes to protect downstream areas by diverting sediment-laden runoff to sediment traps or basins.

Storm water conveyance facilities shall be designed to withstand the expected flow volume and velocity from a design storm.

Sediment basins or traps, strawbale dikes, or silt fences shall be installed below denuded areas so that runoff will be detained long enough for suspended sediment to settle out prior to being pumped over the levee or into the forebay.

Disturbed slopes adjacent to waterways shall be stabilized using revetment or other appropriate materials.

Maintenance schedules and instructions shall be developed for maintaining control measures.

Construction operations shall be conducted as to minimize the creation and dispersion of dust. Dust control shall be used during all stages of the work and shall consist of applying either water or dust palliative or both, to alleviate or prevent dust nuisance.

5.5 Comparative Evaluation Of The Alternatives

5.5.1 Enlargement Of Clifton Court Forebay, Construction Of Two Intake Structures, Increased Export Capability, And Construction Of Permanent Barriers

This alternative, the original South Delta Water Management Program preferred alternative, would entail construction and operation of the barriers proposed as a part of ISDP. Accordingly, this alternative would have the same barrier-related effects related to seismicity and construction. In addition, this alternative would substantially enlarge Clifton Court Forebay from its current size of 2,100 surface acres to more than 5,000 surface acres using the northern portion of Victoria Island and the remaining area of Clifton Court Tract. Two new northern intake structures would be built, one at the confluence of North Victoria Canal and Middle River and the second at the confluence of North Victoria Canal and Old River. The southeast portion of Byron Tract would hydraulically connect the existing forebay to the new area, and realignment of Highway 4 would be necessary, requiring construction of a new roadway parallel to the existing roadway alignment. Enlargement of the forebay would affect agricultural lands in the area and would involve impacts related to soils, seismicity, construction, seepage, mineral resources, and velocity changes as described in the following.

Soils. Enlargement of Clifton Court Forebay would involve the submersion of approximately 2,900 acres of Class III and IV agricultural lands. The irretrievable commitment of important agricultural lands to non-agricultural uses is considered a significant and unavoidable impact.

Seismicity. This alternative would potentially expose additional facilities to strong ground shaking and liquefaction in the event of an earthquake greater than about 6.5 on the Richter scale on any one of the active faults in the San Francisco Bay region. Seismic damage to the additional facilities would be considered a significant adverse impact.

Grading and Excavation. Enlargement of the Clifton Court Forebay would involve the construction of a 19 mile long embankment. Construction of this embankment would require extensive grading and excavation and the placement of large quantities of fill. These activities could lead to erosion, and sedimentation. Uncontrolled runoff from the construction site could enter surface waters causing increased turbidity and a reduction in water quality. Uncontrolled discharges of sediment and storm water runoff to the waters of the State is considered a significant adverse impact.

In addition, the placement of fill and operation of heavy machinery and equipment could cause substantial soil blowing. During smaller construction projects, the risk of soil blowing can be reduced by applying water or dust palliatives to the construction site and access roads. In this case, however, soil blowing will be more difficult to control owing to the large work area and placement of fill. The proximity of Highway 4 to the construction site increases the concern. Extensive soil blowing is considered a significant adverse impact.

Seepage. Expansion of the reservoir could increase seepage within the southern portion of Victoria Island. Increased seepage could be expected because the water levels within the impoundment would be higher than the surrounding land surface. The difference in elevations increases pressure in the underlying aquifer and the possibility of seepage. Seepage within the southern portion of Victoria Island would lead to increased pumping and drainage costs and, possibly a reduction in crop production. These consequences are considered significant adverse impacts.

Mineral and Natural Gas Resources. Construction of the new levees and equipment storage area would require approximately 320,000 cubic yards of sand, gravel, and rock. This rock would be imported from the Vernalis area. Using these materials would reduce aggregate reserves in the County and may affect the short term availability of aggregate for local projects. However, according to the San Joaquin County General Plan (1992), alternative sources of aggregate are available in adjacent locations in the San Joaquin Valley, the lower Sacramento Valley, and in the San Francisco Bay area. Therefore, a short term reduction in the availability of aggregate is not considered a significant adverse impact.

Velocity Changes/Scouring. The effects to existing within Delta flows for this alternative would differ from those modeled for ISDP, as follows: 1) changes in velocity may cause localized scour; 2) there would be a minor change in circulation patterns in the South Delta from those modeled for the preferred alternative; and 3) there would be a minor change in water surface elevations downstream of the flow barriers.

The flow velocities in the channels north of Victoria Island would be changed by the new intakes. The two intakes on Victoria Island, one at Old River and one at Middle River, would cause the effects of increased diversions to be shared by both channels. Based on previous modeling efforts (DWR 1990a), velocities in Middle River would be less than 3.0 fps and are not likely to induce scouring. Velocities in Old River, however, may increase to above 3.0 fps under some conditions. Models and previous studies have shown that velocities greater than 3.0 fps cause scouring of the channel. Scouring of the channel could lead to levee undermining and habitat losses. These consequences are considered significant adverse impacts.

Implementation of this alternative would preclude the use of the existing Clifton Court intake. As such, channel velocities in West Canal, near the existing intake, would decrease. Based on previous modeling efforts (DWR 1990a), velocities in West Canal could drop by over 33 percent from the existing condition. This decrease is not anticipated to cause increased sediment deposition, since the existing velocities are near the scour limit of 3.0 fps when the intake is operating. As such, significant adverse impacts related to velocity changes, scouring, or sediment are not expected.

The effects of the barriers would be similar under this alternative to those modeled for the preferred alternative. Downstream of the barriers, this alternative would have less of an influence than the preferred alternative owing to the difference in the location of the intakes. Downstream of the barriers, water surface elevation would be slightly higher and velocity would be slightly lower than those modeled for the preferred alternative. As a result, no significant adverse impacts involving scouring near the barrier sites are expected.

- *Mitigation*

Seismicity. All new structures associated with this project shall be designed and constructed to resist seismic effects as provided in the Uniform Building Code (UBC). The embankment would be constructed according to the provisions of the State Dam Safety Regulations. In addition, all new structures shall be designed to meet the implementation standards outlined in the San Joaquin and Contra Costa County General Plans. Implementation of the policies and goals outlined in the General Plans, adherence to specific County Building Codes, and adherence to the UBC guidelines and Dam Safety Standards would reduce the hazards associated with earthquakes to a less-than-significant level.

Materials Transport. This alternative involves greater potential for soil blowing than ISDP because of the scale of the construction and the need to transport substantial amounts of soil for construction. The following mitigation measures would be needed for this alternative in addition to those noted for ISDP.

> *Open bodied trucks shall be covered when used for transporting materials likely to give rise to airborne dust.*
>
> *Water or chemical palliatives shall be used for control of dust in during the construction of building or structures and the grading of roads and clearing of land.*

Asphalt, water or suitable chemicals shall be applied to dirt roads, materials stockpiles, and other surfaces which can give rise to airborne dusts.

Earth or other material shall be promptly removed from paved streets onto which earth or other material has been transported by trucking or earth moving equipment, erosion by water, or other means.

Seepage. Impacts related to seepage would be mitigated by implementing a Seepage Monitoring Program and compensating local farmers for increased pumping costs and losses that result from seepage. The Seepage Monitoring Program would monitor changes in pumping rates, costs and crop production to determine the extent to which seepage is occurring. Based on the findings of the Seepage Monitoring Program, DWR shall compensate farmers affected by seepage for their increased pumping costs and crop losses.

Velocity Changes. Increased velocities in Old River could lead to scouring and possibly levee undermining. These impacts are considered significant. Scouring shall be reduced by stabilizing affected banks and channels with riprap or other appropriate materials. Stabilizing the banks and channels would reduce this adverse impact to a less-than-significant level.

5.5.2 Reduction Of CVP/SWP Exports And Management Or Reduction Of Demand For SWP Water

This alternative would incorporate reductions in the amount of water exported to SWP water users, along with implementation of measures in the service areas to either better manage the available water or to reduce the demand for water. The project facilities proposed for ISDP would not be constructed or operated. Implementation of this alternative would not result in any negative effects related to geology and soils.

5.5.3 Modification Of CVP/SWP Exports, Consolidation Of Agricultural Diversions, Extension Of Existing Agricultural Diversions, And Increased Pumping At Harvey O. Banks Up To 10,300 cfs.

This alternative would include the ISDP actions involving the dredging of 4.9 miles of Old River and the construction and operation of a new intake facility at Clifton Court Forebay. However, under this alternative, the construction and operation of the ISDP flow and fish barriers would not occur. Instead, the alternative would include the consolidation of agricultural diversions, extending and screening 44 additional agricultural diversions, and dredging portions of Paradise Cut, Middle River, and Old River. The following is a discussion of impacts expected to occur with the construction and operation of the consolidated agricultural diversions.

Soils. The consolidation of agricultural diversions as proposed under this alternative would take at least an additional 400 acres of agricultural lands out of production. The amount of dredged material for disposal would increase the settling pond land requirement by about 1,080 acres, thus temporarily removing these lands from production as well. These would be considered unavoidable significant adverse impacts of this alternative.

Construction Impacts. This alternative would involve the construction of about 11.5 miles of water pipeline and ten regulating reservoirs. The area covered by the regulating reservoirs totals about 400 acres. The grading and excavation associated with the construction of these facilities could result in excess sedimentation and erosion, and consequently uncontrolled runoff and water quality degradation. These consequences are considered significant adverse impacts.

Velocity Changes/Scouring. This alternative calls for consolidating agricultural diversions, extending other diversions, and dredging to accommodate the extended diversions. The consequences of the increased withdrawals from the Delta channels adjacent to the pumps has not been quantitatively modeled. However, increased flow rates are expected to lead to increased scour potential in the vicinity of the pumps and in nearby channel segments. There could be local changes to Delta circulation patterns, such as localized reverse flow. These localized changes, however, are not expected to substantially alter the channel configuration. As such, these adverse impacts are not considered significant.

- *Mitigation*

Construction Impacts. Construction activities could cause excessive erosion and sedimentation. Excessive erosion and sedimentation related to grading and excavation activities shall be reduced to less-than-significant levels by: 1) implementing standard erosion and sediment control practices; and 2) complying with the State Water Resources Control Board's General Construction Activity Storm Water Permit requirements.

5.5.4 ISDP Project With An Additional Clifton Court Forebay Intake At Italian Slough

This alternative would provide all of the proposed components of the ISDP project, plus a new intake at Italian Slough. Thus, the alternative would include two intakes, one at Italian Slough and one at the northeastern corner of Clifton Court Forebay. Implementation of this alternative would result in all of the effects associated with the ISDP, plus incremental seismic risk and grading and excavation effects owing to the construction of an additional intake structure. This alternative would include potentially significant adverse impacts in connection with water velocity changes, as described in the following.

Velocity Changes/Scouring. The impacts to existing within-Delta flows for this alternative would differ from those modeled for the preferred alternative in that changes in velocity may cause localized scour near the intake and in Italian Slough. No modeling of the magnitude of the increases has been performed, but velocities may increase to above 3.0 fps under some conditions. Scouring of the channel could, in turn, lead to levee undermining, which would be considered a significant adverse impact.

- *Mitigation*

Velocity Changes/Scouring. Scouring shall be reduced by stabilizing affected banks and channels with riprap or other appropriate materials. Stabilizing the banks and channels would reduce this adverse impact to a less-than-significant level.

5.5.5 ISDP Without The Northern Intake, And With An Expanded Existing Intake

This alternative would implement all of the proposed components of the ISDP project, except construction of a new intake at the northeastern corner of Clifton Court Forebay. Instead, the existing Clifton Court Forebay intake and West Canal would be expanded to accommodate the additional flow. Implementation of this alternative would result in all of the effects associated with the ISDP, except those associated with ISDP's proposed northern intake. This alternative would include the environmental effects of expanding the existing Clifton Court Forebay intake structure, and would potentially create scour-related significant adverse impacts, as outlined in the following.

Velocity Changes/Scouring. The impacts to existing within Delta flows for this alternative would differ from those modeled for the preferred alternative, as follows: 1) changes in velocity may cause localized scour near the enlarged intake; and 2) there would be a minor change in circulation patterns in the South Delta from those modeled for the preferred alternative.

The flow velocities in West Canal and Old River would be changed by the enlarged intake. No detailed modeling has been performed to evaluate the change, but velocities in channels may exceed the 3.0 fps and are likely to induce scouring. Scouring could, in turn, lead to levee undermining. This would be considered a significant adverse impact.

There would be a change in local South Delta circulation patterns under this alternative, compared to the preferred alternative. When the flow barriers are not operating, channel velocities in the reaches of Middle River, Grant Line Canal, and Old River that are upstream of the barriers will be greater using the enlarged intake of this alternative. When the barriers are operational, water surface elevation may decrease and velocities may increase downstream of the barriers on Old River near DMC and in Grant Line Canal. The velocities may exceed the 3.0 fps and are likely to induce scouring. Scouring could, in turn, lead to levee undermining. This would be considered a significant adverse impact.

- *Mitigation*

Velocity Changes/Scouring. Scouring shall be reduced by stabilizing affected banks and channels with riprap or other appropriate materials. Stabilizing the banks and channels will reduce this impact to a less-than-significant level.

5.5.6 No Action (Maintain Existing Conditions)

This alternative would involve the maintenance of environmental conditions as they presently exist in the south Delta. The ISDP would not be approved or constructed. The potential adverse environmental effects of the ISDP project would not occur, nor would the potential water supply, water quality, and environmental benefits occur. None of the proposed actions would affect geologic resources. Accordingly, the geologic conditions in the project area would stay the same, without the influence of construction and operation of ISDP.

5.5.7 No Action (Maintain Conditions As They Would Exist In The Future)

This alternative primarily involves water management procedures in the SWP service areas, such as water conservation measures in urban areas, agriculture efficient water management practices, land retirement and water transfers. Implementation of this alternative would result in the maintenance of environmental conditions as they will exist in the future, without construction or operation of ISDP. None of the proposed actions would affect geologic resources. Accordingly, the geologic conditions in the project area would either stay the same or change, without the influence of construction and operation of ISDP.